

Appl. No. 10/650,504
Amdt. Dated December 20, 2005
Reply to Office Action of September 26, 2005

Attorney Docket No. 81872.0052
Customer No.: 26021

REMARKS/ARGUMENTS

Claims 1, 6, 13, 15, 17, 19, 20 and 22 are amended. Claim 23 is new. Claims 1-23 are pending in the application. Reexamination and reconsideration of the application, as amended, are respectfully requested.

An object of the present invention is to provide a dry etching apparatus and a dry etching method that make it possible to form texture homogeneously on the surface of a substrate, and a plate and tray used therein. (Applicants specification at p.5 lines 4-7).

OBJECTION TO DRAWINGS:

The drawings stand objected to under 37 CFR 1.83(a) as failing to show every feature of the invention specified in the claims. The Office states that the concave substrate-placing surface of the tray must be shown.

In response, Applicant has amended Fig. 9 and replaced it with Fig. 9a, Fig. 9b, and Fig. 9c, which show the concave substrate placing surface of the tray. No new matter has been added. A description of the concave substrate-placing surface of the tray 13 can be found in the Applicant's specification at p. 20 lines 13-21. It would be ordinary and clear to one skilled in the art that Fig. 9a, Fig. 9b, and Fig. 9c meet the technical specification found therein.

Withdrawal of this objection is thus respectfully requested.

OBJECTION TO SPECIFICATION:

The specification stands objected to as failing to provide proper antecedent basis for the claimed subject matter. The Office states that a basis for claim 6 appears to be missing from the specification. Applicant respectfully traverses this objection.

Applicant respectfully submits that the proper basis for claim 6 appears in the specification. Claim 6 is written as follows:

The dry etching apparatus according to claim 1, further comprising a tray provided inside said chamber for placing said substrate to be etched on a substrate-placing surface thereof; wherein the substrate placing surface of said tray forms a concave or nearly concave plane as a whole.

A discussion of the concave or nearly concave plane of the substrate placing surface of claim 6 can be found in the specification at p.20 lines 13-21. The specification specifically teaches that in order to implement one aspect of the invention placing tray 13 of Figure 9 may be structured so that it is thicker in the peripheral portion than in the central portion. The resultant concavity may be either in the form of a curve, or in the form of a step-like structure. (Applicant's specification, at p. 20, lines 13-21). The Applicant submits that this discussion in combination with the claim of a dry etching apparatus in original Claim 1, from which Claim 6 depends, provides proper "antecedent basis" for the dry etching apparatus of claim 6 with concave or nearly concave substrate placing surface of a tray. Withdrawal of this objection is thus respectfully requested.

CLAIM REJECTIONS UNDER 35 U.S.C. §102:

Claims 1 and 2 stand rejected under 35 U.S.C. §102(b) as being anticipated by JP 61-238981 A ("JP '981"). Applicant respectfully traverses this rejection. Claim 1, as amended, is as follows:

A dry etching apparatus, comprising: a chamber; a substrate to be etched, placed inside said chamber; and a plate provided with a number of opening portions and prepared to cover said substrate to be

etched, wherein said plate is arranged in such a manner that, while covering said substrate to be etched, a distance between a surface opposing said substrate to be etched and said substrate to be etched in a peripheral portion is shorter than a distance between the surface opposing said substrate to be etched and said substrate to be etched in a central portion.

Applicant respectfully submits that JP '981 cannot anticipate claim 1 because it fails to teach that "a distance between a surface opposing a substrate to be etched and said substrate to be etched in a peripheral portion is shorter than a distance between the surface opposing said substrate to be etched and said substrate to be etched in a central portion" as required by claim 1. (emphasis added). Figure 7 of JP '981 teaches a convex shape of the surface of a plate 6 which opposes the substrate to be etched. Therefore, JP '981 teaches a distance between a surface opposing a substrate to be etched and the substrate to be etched in a peripheral portion that is longer than a distance between the surface opposing the substrate to be etched and the substrate to be etched in a central portion, producing a consistent rate of etching. This contrasts with the apparatus claimed in Claim 1 by Applicant, wherein the spacing between the surface of the plate opposing the substrate to be etched and the substrate to be etched allows for controlled residue binding during the etching process and produces a consistent texture of etching across the surface of the substrate. (Applicant's specification at p. 5 line 20- p.6 line 7). The resultant homogeneously etched texture of the substrate serves to reduce reflectance from solar cells and thereby increase their efficiency, which is an object of the invention. (Applicant's specification at p.3 lines 15-23).

In light of the foregoing, Applicant respectfully submits that JP '981 could not have anticipated or rendered obvious claim 1, because JP '981 fails to teach or suggest each and every claim limitation.

Claim 2 depends from claim 1 and cannot be anticipated or rendered obvious for at least the same reasons as claim 1. Withdrawal of these rejections is thus respectfully requested.

Claims 13 and 14 stand rejected under 35 U.S.C. §102(b) as being anticipated by JP '981. Applicant respectfully traverses this rejection.

Applicant respectfully submits that JP '981 cannot anticipate claim 13. Claim 13 is directed to a method of dry etching a substrate. Like claim 1, claim 13 requires that "a distance between a surface opposing said substrate to be etched and said substrate to be etched in a peripheral portion is shorter than a distance between the surface opposing said substrate to be etched and said substrate to be etched in a central portion." As such, claim 13 is patentable for at least the same reasons as claim 1.

In light of the foregoing, Applicant respectfully submits that JP '981 could not have anticipated or rendered obvious claim 13, because JP '981 fails to teach or suggest each and every claim limitation.

Claim 14 depends from claim 13 and cannot be anticipated or rendered obvious for at least the same reasons as claim 13. Withdrawal of these rejections is thus respectfully requested.

Claim 15 stands rejected under 35 U.S.C. §102(b) as being anticipated by JP '981. Applicant respectfully traverses this rejection.

Applicant respectfully submits that JP '981 cannot anticipate claim 15 as originally written because it fails to teach a plate "placed inside a chamber, said plate having: a number of opening portions; and a surface opposing said substrate

to be etched and being shaped into a concave or nearly concave plane as a whole.” Figure 7 of JP ‘981 teaches a plate that has a convex surface opposing a substrate to be etched.

In light of the foregoing, Applicant respectfully submits that JP ‘981 could not have anticipated or rendered obvious claim 15, because JP ‘981 fails to teach or suggest each and every claim limitation. Withdrawal of this rejection is thus respectfully requested.

Claim 16 stands rejected under 35 U.S.C. §102(b) as being anticipated by JP ‘981. Applicant respectfully traverses this rejection.

Applicant respectfully submits that JP ‘981 cannot anticipate claim 16 as originally written because it fails to teach a “tray used for a dry etching apparatus and provided inside a chamber so that a substrate to be etched is placed thereon while said substrate to be etched is covered with a plate, said tray having: a substrate-placing surface shaped into a concave or nearly concave plane as a whole.” (emphasis added). Figure 7 of JP ‘981 teaches a flat electrode 3 on which a substrate is placed for etching. It is a discovery of the current invention that the concave or nearly concave substrate placing surface of a tray allows substrate at the periphery of the tray to be aligned closer to the plate used in etching than the substrates in the central portion of the tray. (Applicant’s specification at p. 19 line 24- p.20 line 5). In turn, this promotes residue binding in the periphery and yields a homogeneous texture on the substrate surface.

In light of the foregoing, Applicant respectfully submits that JP ‘981 could not have anticipated or rendered obvious claim 16, because JP ‘981 fails to teach or suggest each and every claim limitation. Withdrawal of this rejection is thus respectfully requested.

Claims 17-19 stand rejected under 35 U.S.C. §102(b) as being anticipated by Jurgensen et al (US 6,261,406 B1). Applicant respectfully traverses this rejection. Claim 17, as amended, is as follows:

A dry etching apparatus, comprising: a chamber; a substrate to be etched, placed inside said chamber; and a plate provided with a number of opening portions and prepared to cover said substrate to be etched, wherein said plate is provided with a protruding wall on a surface opposing said substrate to be etched and said protruding wall is separated from a nearest surface of said substrate by a gap.

Applicant respectfully submits that Jurgensen cannot anticipate claim 17 as amended because it fails to teach that a "protruding wall is separated from a nearest surface of said substrate by a gap." Jurgensen teaches a confinement device used for operative arrangement within a substrate etching chamber. (column 8, lines 21-25). In the preferred system disclosed by Jurgensen that is shown in Figure 1, a device 12 that resembles a wall remains in contact with the perimeter of the substrate to help with placing. (column 10, lines 27-28). Jurgensen does not present the possibility of separating the device from the substrate. Jurgensen therefore fails to teach or suggest an apparatus wherein a protruding wall of a plate is separated from the nearest surface of a substrate to be etched by a gap.

In Applicant's invention, the presence of a protruding wall surrounding a substrate is beneficial because it helps trap residues during dry etching which bind to the substrate and increase the homogeneity of the etching. (Applicant's specification p. 21 line 23- p.22 line 6). In contrast to Jurgensen, however, it is a discovery of Applicant's invention that when substrate comes into direct contact with or too close to a protruding wall the substrate is not etched in that region.

(Applicant's specification, p. 22, lines 13-18). Therefore, a gap is maintained between the protruding wall and a nearest surface of said substrate to be etched.

In light of the foregoing, Applicant respectfully submits that Jurgensen et al (US 6,261,406 B1) could not have anticipated or rendered obvious claim 17, because Jurgensen fails to teach or suggest each and every claim limitation.

Claim 18 depends from claim 17 and cannot be anticipated or rendered obvious for at least the same reasons as claim 17. In addition, claim 18 claims a dry etching apparatus wherein a protruding wall is formed in a shape of a cross when viewed in a plane. There is no such structure disclosed Jurgensen. It is a discovery of Applicant's invention that the use of a cross shaped protruding wall allows for the reduction in the size of the region in which a substrate is being etched, and contributes to an increase in homogeneity of the etched substrate. (Applicant's specification, p. 22 lines 7-12).

In light of the foregoing, Applicant respectfully submits that Jurgensen et al (US 6,261,406 B1) could not have anticipated or rendered obvious claim 18, because Jurgensen fails to teach or suggest each and every claim limitation.

Claim 19 depends from claim 17 and cannot be anticipated or rendered obvious for at least the same reasons as claim 17. Withdrawal of the rejections of claims 17-19 is thus respectfully requested.

Claims 20-21 stand rejected under 35 U.S.C. §102(b) as being anticipated by Jurgensen et al (US 6,261,406 B1). Applicant respectfully traverses this rejection. Claim 20, as amended, is as follows:

A dry etching method etching a surface of a substrate to be etched, said method comprising: placing a substrate to be etched inside a chamber; and covering said substrate to be etched with a plate provided with a number of opening portions, wherein a protruding wall

is provided to said plate on a surface opposing said substrate to be etched and said protruding wall is separated from a nearest surface of said substrate by a gap.

Applicant respectfully submits that Jurgensen cannot anticipate claim 20 as amended. Claim 20 is directed to a method of dry etching. Like claim 17, claim 20 requires that "a protruding wall is provided to said plate on a surface opposing said substrate to be etched and said protruding wall is separated from a nearest surface of said substrate by a gap." As such, claim 20 is patentable for at least the same reasons as claim 17.

In light of the foregoing, Applicant respectfully submits that Jurgensen et al (US 6,261,406 B1) could not have anticipated or rendered obvious claim 20, because Jurgensen fails to teach or suggest each and every claim limitation.

Claim 21 depends from claim 20 and cannot be anticipated or rendered obvious for at least the same reasons as claim 20. Withdrawal of these rejections is thus respectfully requested.

Claims 22 stands rejected under 35 U.S.C. §102(b) as being anticipated by Jurgensen et al (US 6,261,406 B1). Applicant respectfully traverses this rejection.

Like claim 20, claim 22 as amended requires "a protruding wall formed at least in a peripheral portion of a surface opposing said substrate to be etched such that said protruding wall is separated from a nearest surface of said substrate by a gap." As such, claim 22 is patentable for at least the same reasons as Claim 20.

In light of the foregoing, Applicant respectfully submits that Jurgensen et al (US 6,261,406 B1) could not have anticipated or rendered obvious claim 22, because Jurgensen fails to teach or suggest each and every claim limitation. Withdrawal of this rejection is thus respectfully requested.

CLAIM REJECTIONS UNDER 35 U.S.C. §103:

Claims 3-10 stand rejected under 35 U.S.C. §103 as being unpatentable over JP 61-238981 A ("JP '981") in view of JP 02-106925 A ("JP '925"). Applicant respectfully traverses this rejection. Claim 3 is as follows:

The dry etching apparatus according to claim 2, wherein the surface of said plate opposing said substrate to be etched forms a step-like structure.

Claim 4 is as follows:

The dry etching apparatus according to claim 3, wherein chamfering is applied to a step portion in the step-like structure.

Claim 5 is as follows:

The dry etching apparatus according to claim 2, wherein a thickness of said plate is thicker in the peripheral portion than in the central portion.

Claim 6, as amended, is as follows:

The dry etching apparatus according to claim 1, further comprising a tray provided inside said chamber for placing said substrate to be etched on a substrate-placing surface thereof; wherein the substrate-placing surface of said tray forms a concave or nearly concave plane as a whole.

Claim 2 is as follows:

The dry etching apparatus according to claim 1, wherein the surface of said plate opposing said substrate to be etched forms a concave or nearly concave plane as a whole.

Applicant respectfully submits that the cited references cannot render claims 3 or 5 obvious, because the cited references fail to teach or suggest a plate with

surface opposing a substrate to be etched which “forms a concave or nearly concave plane as a whole” and either “forms a step-like structure” or “is thicker in the peripheral portion than in the central portion.” The Office argues that JP ‘981 teaches the use of a plate with a generally smooth concave surface. It further argues that JP ‘925 teaches the use of step like plates that are thicker at the periphery as useful alternatives to smooth concave plates, and asserts that it would have been obvious to use such a shape.

In response, Applicant respectfully submits that JP ‘981 teaches a plate with a surface opposing a substrate to be etched that is generally convex rather than concave and sits in between a parallel electrode system. In addition, Applicant respectfully submits that the surface taught in JP ‘925 is not a mere plate, but is rather an electrode with a different functionality. Both JP ‘981 and JP ‘925 teach variations of the basic parallel plate counter-electrode etching type as discussed in Applicant’s specification. (Applicant’s specification p. 3 line 24- p.4 line 8). To the extent that there are modifications of shape on either an intermediate plate or an electrode that resemble a convex or stepped structure, they serve to control only the access of plasma to substrate during etching. They represent one method of controlling consistency of the rate of etching in general, which is only one important aspect of the current invention.

Consequently, nothing in JP ‘981 or JP ‘925 teaches or suggests another discovery of the present invention, which is that a homogeneous etching texture can be formed on a substrate when plasma is exposed to a substrate in close proximity to a concave or nearly concave, smooth or stepped plate. The shape of the plate in the current invention is important to the development of texture during etching because an optimal distance between the plate and substrate assists in binding residues to the substrate during etching. At shorter distances, residue binding is

increased. Increased residue slows etching in the bound region, which results an inconsistent etching rate across the surface and ultimately a textured surface. (Applicant's specification, p 17 line 15 – p.18 line 10). The shape of the plates as claimed in claims 3 and 5 is needed in order to soundly promote residue binding at the edges of a substrate, which otherwise form texture at lower rates, so that the texture across the substrate surface can be homogeneous. This discovery is not taught or suggested by JP '981 or JP '925, nor do either appear to produce or attempt to produce a homogeneously textured substrate that reflects less light.

In addition, Applicant respectfully submits that the cited references cannot render claim 6 obvious because they fail to teach or suggest a tray for placing substrate that "forms a concave or nearly concave plane as a whole." In contrast the curved or stepped plates and electrodes taught by JP '981 or JP '925, the concave or nearly concave structure of the substrate placing tray claimed in claim 6 places a substrate to be etched in optimal proximity to a plate during etching to promote residue formation at the periphery. This in turn promotes homogeneity in the texture that is created during etching.

Applicant submits that the cited references cannot render claim 10 obvious because they fail to teach or suggest a dry etching apparatus that contains a plate covering a substrate to be etched wherein the distance between the plate and the substrate to be etched is lesser at the periphery than at the central portion and "wherein a distance between said plate and said substrate is 5 to 30 mm." JP '981 teaches only a convex plate used to control plasma speed during etching. It is a discovery of the current invention that the use of a plate that remains 5mm to 30mm from a substrate to be etched and is closer to the substrate at the periphery than at the center optimizes the balance between etching a pattern of the plate on the substrate and etching a flat substrate without texture. (Applicant's

specification p.14 lines 16-24). This has the effect of creating a homogeneous texture on an etched substrate that is useful for preventing reflection of light from the substrate surface.

In light of the foregoing, Applicant respectfully submits that JP '981 and JP '925 could not have made claims 3, 5, 6, or 10 obvious, because the combination of references fails to teach or suggest each and every claim limitation.

Claim 4 depends from claim 3, and cannot be made obvious for at least the same reasons as claim 3. Claims 7 and 9 depend from claim 6 and cannot be made obvious for at least the same reasons as claim 6. Claim 8 depends from claim 7 and cannot be made obvious for at least the same reasons as claim 7. Withdrawal of these rejections is thus respectfully requested.

Claims 11 and 12 stand rejected under 35 U.S.C. §103 as being unpatentable over JP '981 in view of Becker et al (US 6,214,161 B1). Applicant respectfully traverses this rejection. Claim 11 is as follows:

The dry etching apparatus according to claim 1, wherein said plate is made of metal.

Applicant respectfully submits that the cited references cannot render claims 11 or 12 obvious, because the cited references fail to teach or suggest a dry etching apparatus that contains a plate covering a substrate to be etched wherein the distance between the plate and the substrate to be etched is lesser at the periphery than at the central portion and wherein the plate is made of metal. The Office argues that it would have been obvious to use a metal to form the apparatus and method of JP '981 because Becker teaches that metals are useful materials for plates in plasma reactors.

In response, Applicant respectfully submits that JP '981 teaches a plate with a surface opposing a substrate to be etched that is convex rather than concave and

sits in between a parallel electrode system. This plate serves only to control the access of plasma to substrate during etching. Becker teaches that metal plates made from materials such as aluminum can be used in an apparatus to shield plasma or create orifices. (column 3, lines 51-57). Consequently, nothing in JP '981 or Becker teaches or suggests the use of metal or aluminum as a material for a plate that functions to promote residue binding and a homogeneous texture on an etched substrate. Metal is useful as a material for the plate because it is less brittle than glass and will not break when large plates are used. (Applicant's specification p. 15 lines 17-23). Specifically, aluminum has been found to be a useful metal because it is light in weight and resistant to distortion during the etching process. (Applicant's specification p.16 lines 7-12). This allows the plate to maintain a constant distance from the substrate to be etched during etching and perform its function in encouraging residue binding in the periphery.

In light of the foregoing, Applicant respectfully submits that JP '981 and Becker et al (US 6,214,161 B1) could not have made claims 11 or 12 obvious, because the combination of references fails to teach or suggest each and every claim limitation. Withdrawal of these claims is thus respectfully requested.

NEW CLAIM 23:

The Applicant has added new claim 23. Claim 23 is as follows:

The dry etching apparatus according to Claim 17, wherein said protruding wall abuts on an electrode.

The Applicant respectfully submits that no new matter is added in new claim 23, and that support for claim 23 can be found in the specification: "As shown in Fig. 12, it is preferable that the lower end portion 21 of the protruding wall abuts on the electrode 9 or the tray 13." (Applicant's specification p. 22 lines 19-21).

Appl. No. 10/650,504
Amdt. Dated December 20, 2005
Reply to Office Action of September 26, 2005

Attorney Docket No. 81872.0052
Customer No.: 26021

In addition, the Applicant respectfully submits that the prior art neither anticipates nor renders obvious new claim 23. Claim 23 depends from claim 17, and cannot be anticipated or rendered obvious for at least the same reasons as claim 23. Allowance of this claim is thus respectfully requested.

The art made of record but not relied upon by the Examiner has been considered. However, it is submitted that this art neither describes nor suggests the presently claimed invention.

In view of the foregoing, it is respectfully submitted that the application is in condition for allowance. Reexamination and reconsideration of the application, as amended, are requested.

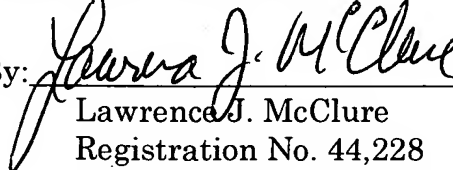
If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles, California telephone number (213) 337-6810 to discuss the steps necessary for placing the application in condition for allowance.

If there are any fees due in connection with the filing of this response, please charge the fees to our Deposit Account No. 50-1314.

Respectfully submitted,

HOGAN & HARTSON L.L.P.

By:



Lawrence J. McClure
Registration No. 44,228
Attorney for Applicant(s)

Date: December 22, 2005

500 South Grand Avenue, Suite 1900
Los Angeles, California 90071
Phone: 213-337-6700
Fax: 213-337-6701

Appl. No. 10/650,504

Attorney Docket No. 81872.0052

Amdt. Dated December 20, 2005

Customer No.: 26021

Reply to Office Action of September 26, 2005

Amendments to the Drawings:

The attached sheet of drawings includes changes to Figures 9a, 9b, and 9c.

Attachments: Replacement Sheet

Annotated Sheet Showing Changes



FIG. 8

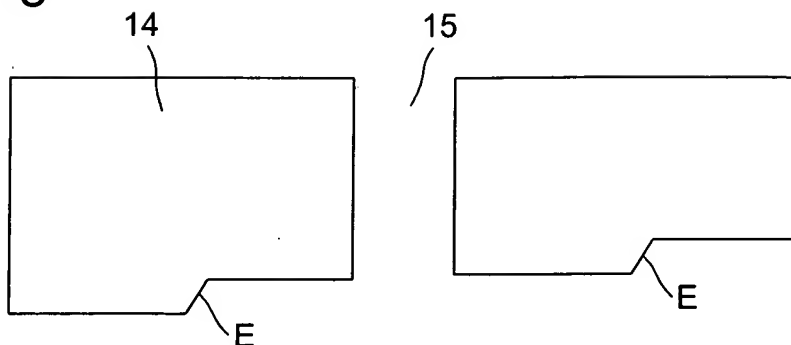


FIG. 9a

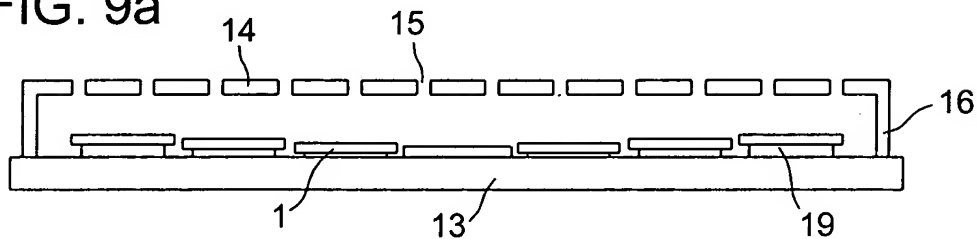


FIG. 9b

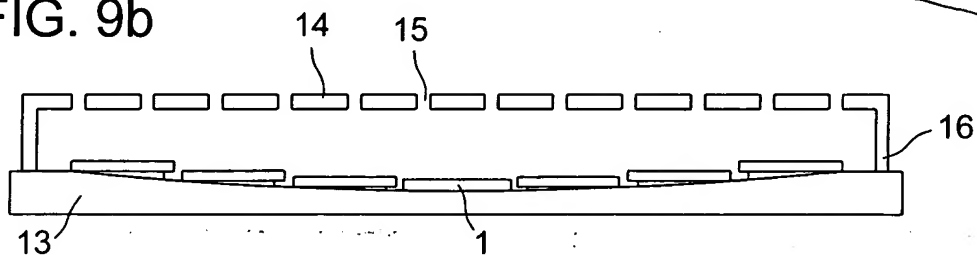


FIG. 9c

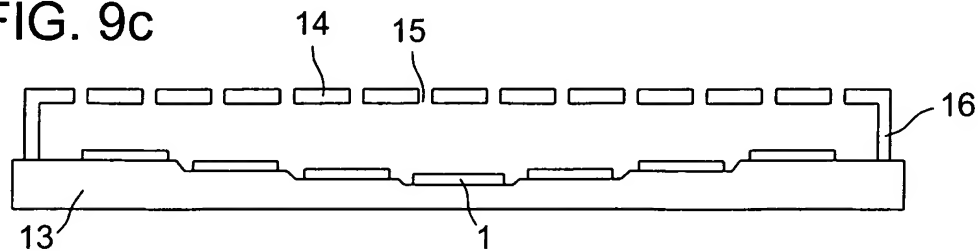
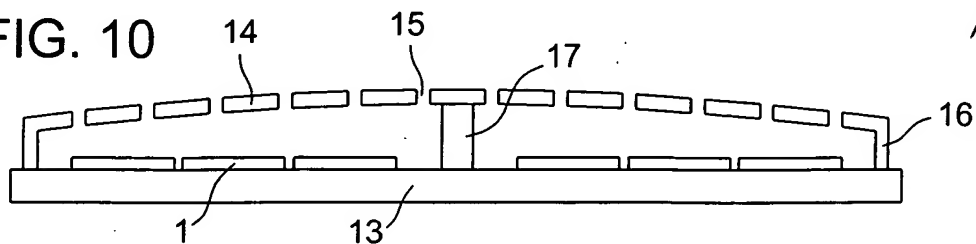


FIG. 10



ADDED